

WORLD METEOROLOGICAL ORGANIZATION

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COMMISSION FOR AERONAUTICAL METEOROLOGY

ITEM 6

TWELFTH SESSION

MONTREAL, 16 TO 20 SEPTEMBER 2002

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## **AERONAUTICAL METEOROLOGICAL CODES**

### **Verification of Aerodrome Forecasts**

*(Submitted by Hong Kong, China)*

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#### **Summary and Purpose of Document**

This document reports on a TAF verification scheme implemented by Hong Kong, China.

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#### **ACTION PROPOSED**

The Commission is invited to:

- (a) Note the information contained in this document;
- (b) Approve the draft text in the Appendix for inclusion in the general summary of CAeM-XII.

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**Appendix:** Draft text for inclusion in the general summary of CAeM-XII.

## 1. INTRODUCTION

To objectively assess the accuracy of its aviation weather forecasts and to identify areas for further improvement, Hong Kong, China has developed and implemented a scheme to verify aerodrome forecast (TAF) for the Hong Kong International Airport (HKIA). The verification scheme covers seven weather elements, viz. wind direction and speed, visibility, precipitation, cloud amount and height, and air temperature.

## 2. METHODOLOGY AND CONSIDERATIONS FOR VERIFICATION SCHEME

2.1 The scheme aims at obtaining verification statistics in terms of the percentage of correct forecast of the seven weather elements, in accordance with the guidance on operational desirable accuracy of aerodrome forecast given in ICAO Annex 3 / WMO Technical Regulations [C.3.1]. The guidance prescribes desirable limits of deviation of the forecast from the observed values for these weather elements.

2.2 The scheme compares the forecast values of these elements with the observed values recorded in all available METAR/SPECI reports. Each forecast consists of a main forecast which may be supplemented by one or more alternate forecasts indicated by TAF change groups, viz. BECMG, TEMPO, PROB and PROB TEMPO. For each weather element in the forecast, the number of hours in which the element has been correctly forecast, i.e. the forecast value(s) falls within the prescribed limits for the element, are counted and the percentage of correct forecast for a user-specified time period, e.g. a certain day, month or year, can thus be established.

2.3 In the implementation of the verification scheme, the following aspects have been considered and taken into account:

- (a) BECMG indicator. Such elements as wind direction and speed, precipitation, cloud amount and height often exhibit marked and sudden changes from one discrete state to another discrete state (e.g. change in wind direction during a frontal passage, or change in precipitation intensity during approach of severe weather). In the verification scheme, the forecast within the time period covered by the BECMG indicator (between time T1 and time T2) is considered correct if either the forecast before the change period (i.e. before T1) or the forecast after the change period (i.e. after T2) agrees with the observations to within the limits prescribed in the ICAO / WMO guidance;
- (b) TEMPO group. Alternate forecast indicated as TEMPO is verified in a similar manner as described in para. 2.3(a) except that the number of hours with the correct alternate forecast will only be counted up to half of the period covered by the TEMPO group (e.g., for a 6-hour TEMPO forecast of precipitation, even if precipitation is reported every hour during the entire period, the forecast is only considered correct for 3 hours). This is because TEMPO is intended for less than one-half of the forecast period during which the alternate forecasts are expected to occur. To encourage the use of TEMPO group only when there is reasonable confidence of occurrence of the alternate forecasts, up to 1/3 of the hours covered by TEMPO forecast will be counted as incorrect if the alternative forecast is never observed (e.g., for a 6-hour TEMPO forecast of precipitation, the forecast is only considered correct for 4 hours if no precipitation is reported during the entire 6-hour period). In this way, hedging with TEMPO forecast is discouraged;
- (c) PROB forecast. As alternate forecasts with probability of occurrence less than 50% are seldom used, PROB forecasts are not verified;
- (d) For those meteorological conditions which are considered operationally insignificant and are not indicated in the TAF, verification is treated as follows:
  - ♦ Wind direction forecasts are not verified when both the forecast and reported wind speeds do not exceed 6 knots (i.e. under calm or light wind conditions);

- ◆ Precipitation forecasts (which may be either null, moderate or heavy precipitation) are not verified when light precipitation is reported;
  - ◆ Only clouds reported with heights below 5 000 ft are considered in the verification of cloud amount and cloud height forecasts;
- (e) To ensure that the length of the TAF messages and the number of changes indicated in the TAF are kept to a minimum, Hong Kong, China adopted a set of criteria following closely those for the issuance of SPECIs for the inclusion of change groups in the forecasts. Specifically for winds, only direction changes of over 60° are indicated in the forecast. For meaningful verification, this 60° criterion is adopted in the verification scheme for wind direction.

### **3. APPLICATION OF THE VERIFICATION RESULTS**

3.1 Verification of TAF for HKIA is carried out on a daily basis. An internal web-based system is employed to enable easy retrieval of verification results to facilitate routine monitoring of forecast performance. The results are reviewed to identify improvement areas in forecasting techniques. They also provide useful input to the process improvement cycle of the HKO quality management system.

3.2 The verification results were presented to airline users. Over the three-and-a-half-year period since the opening of HKIA in 1998, the percentage of correct forecasts for the different weather elements were found to meet the ICAO Annex 3 / WMO Technical Regulations [C.3.1] criteria (figure 1). The verification results provide the users with an objective measure of the accuracy of the forecast for specific weather elements and the availability of this information was generally well received by users. With a better understanding of its performance, users are able to use the forecast product more effectively in their flight planning operations.

### **4. FUTURE WORK**

The TAF verification scheme will be extended to trend-type landing forecast and take-off forecast. Verification of forecasts of user-specified operating minima based on probability of detection (POD) and false alarm rate (FAR) indicators will also be explored.

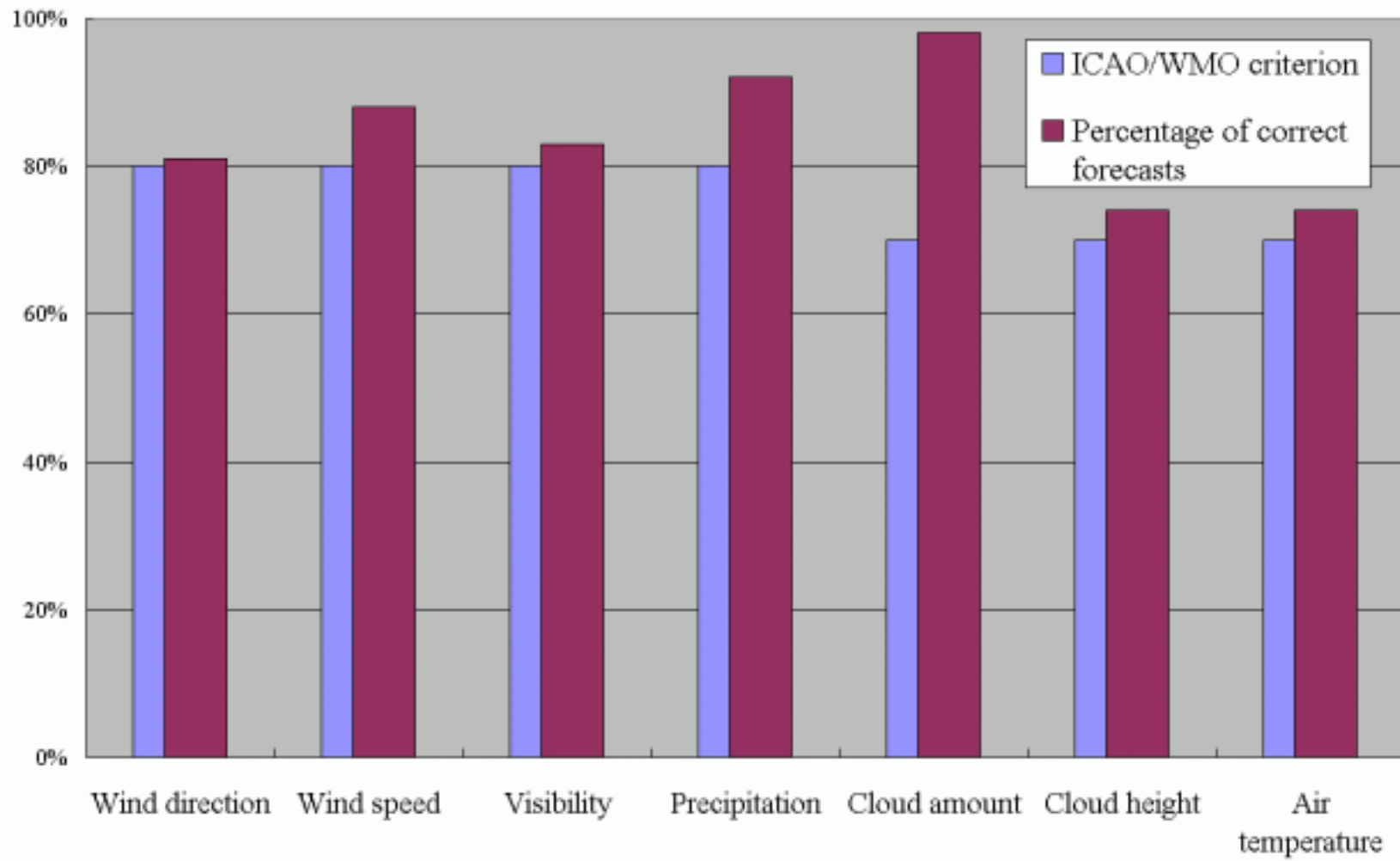


Figure 1. Results of verification of TAF valid for 24 hours (July 1998 - December 2001)

**DRAFT TEXT FOR INCLUSION IN THE GENERAL SUMMARY OF CAeM-XII**

**6. AERONAUTICAL METEOROLOGICAL CODES (*agenda item 6*)**

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***Verification of aerodrome forecasts***

6.15 The Commission noted with interest the progress made by Hong Kong, China in the verification of TAF, the practical considerations made in its implementation, as well as plans for extending the TAF verification scheme to TREND type landing and take-off forecasts.